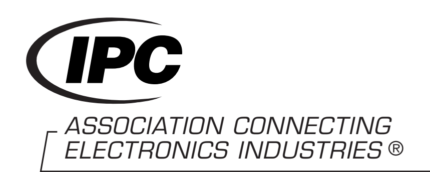


IPC-9151B

Printed Board Process Capability, Quality, and Relative Reliability (PCQR^2) Benchmark Test Standard and Database

IPC-9151B
February 2007

A standard developed by IPC

Supersedes IPC-9151A
May 2003

3000 Lakeside Drive, Suite 309S, Bannockburn, IL 60015-1249
Tel. 847.615.7100 Fax 847.615.7105
www.ipc.org

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- Minimize time to market
- Contain simple (simplified) language
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- Include a feedback system on use and problems for future improvement

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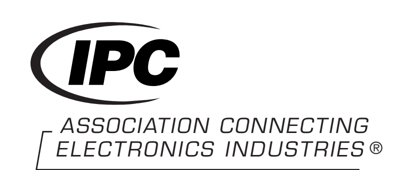
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IPC-9151B

Printed Board Process Capability, Quality, and Relative Reliability (PCQR^2) Benchmark Test Standard and Database

Developed by the PCQR^2 Subcommittee (D-36) of the Rigid Printed Board Committee (D-30) of IPC

Supersedes:
IPC-9151A - May 2003
IPC-9151 - June 2002

Users of this publication are encouraged to participate in the development of future revisions.

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Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the IPC PCQR^2 Subcommittee (D-36) of the Rigid Printed Board Committee (D-30) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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Printed Board Process Capability, Quality, and Relative Reliability (PCQR^2) Benchmark Test Standard and Database

1 SCOPE

1.1 Purpose The purpose of this document is to define the Process Capability, Quality, and Relative Reliability (PCQR^2) Benchmark Test Standard and Database Program used for the evaluation of Printed Circuit Board (PCB) manufacturing processes. This is in accordance with *The National Technology Roadmap for Electronic Interconnections 2000/2001* published by IPC, which states that ''For a company to efficiently manage its supply chain it must identify the capability of its suppliers and make certain that their capability for manufacturing a product is consistent with the needs of the customer.''

1.2 Documentation Hierarchy All other IPC documents take precedence over this document. This document was developed by the IPC D-36 Subcommittee of the Rigid Printed Board Committee (D-30) of IPC, and describes the process to evaluate the manufacturing process capability of PCB fabricators for certain key features.

1.3 Definition of Terms The definition of all terms used herein **shall** be as specified in IPC-T-50 and as defined below.

As Agreed Between User and Supplier (AABUS) Indicates additional or alternate requirements to be decided between the user and the supplier in the procurement documentation.

Analysis Report Detailed statistical data on each fabricator's database submission.

Comparison Report Comparative statistical data of each fabricator participating in the database.

Conductor Analysis Technologies, Inc. (CAT) The company providing and controlling the intellectual property associated with the process capability panel designs, test methods, data analysis techniques, and the database.

Database Submission A set of process capability panels submitted by a fabricator for testing, data analysis, and inclusion in the database.

Database Subscriber A company or organization associated with the electronics industry that obtains access to the database through a subscription from IPC.

Database Supplier A fabricator who submits a set of process capability panels for testing, data analysis, and inclusion in the database.

Design Documentation File The file used to detail the specifications and manufacturing requirements of each process capability panel design.

Design Library The family of process capability panel designs developed by the IPC D-36 Subcommittee.

Fabricator A company or organization that manufactures PCBs.

PCQR^2 Database The electronic storage medium for the data and reports generated from the testing of process capability panels.

Process Capability Data The data generated from the testing of process capability panels.

Process Capability Panel A parametric test panel that is comprised of test modules designed to evaluate specific features of PCBs.

Submission Form The information provided by fabricators upon submitting a set of process capability panels to the database.

Subscription License Agreement The method used by subscribers to gain access to the database which is available at www.pcbquality.com.

Test Module The individual element of a process capability panel.

1.4 Applicable Documents The following specifications of the revision in effect at the time of order form a part of this document to the extent specified herein.

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

2 PROCESS SUMMARY

2.1 Introduction Many PCB users have developed internal processes to evaluate the capabilities of their PCB fabricators. As a result, fabricators often receive requests from multiple customers to manufacture test panels as part of qualification procedures. The PCQR^2 database program provides an industry standard for the design of these test panels. The resulting data provides subscribers with the ability to review detailed results from individual fabricators, to compare the capabilities of multiple fabricators, and to eliminate multiple or redundant requests to fabricators.

2.2 Process Steps

1. At the request of a database subscriber(s) or on their own behalf, fabricators **shall** download the appropriate process capability panel designs, associated documentation files, and submission forms from the design library at www.pcbquality.com.
2. The fabricator manufactures the process capability panels using their standard processes per the specifications and requirements outlined in the design documentation file and AABUS.
3. The fabricator completes the submission form as instructed in the documentation file, and ships all panels at one time. Testing will not begin until all panels and the submission form have been received.
4. CAT or a licensed facility performs the required testing of the process capability panels. All data analysis and report generation **shall** be performed by CAT.
5. Reports and summary information are posted anonymously to the database at www.pcbquality.com.
6. Subscribers are informed of the posting, and the requesting subscriber(s) is informed of the fabricator's identity within the database.
7. The fabricator is provided with a copy of their analysis report and an applicable comparison report for their submission.
8. The process capability panels are not the property of CAT or IPC, and if requested will be returned to the owner when the testing and data analysis has been completed. The panels will be stored for a period of two months from the posting of the data, after which time CAT may dispose of the panels. Unclaimed panels may be used by CAT and/or IPC for other committee approved activities.

3 PROCESS CAPABILITY PANEL DESIGNS

3.1 Design Library The PCQR^2 process capability panel designs are provided under license to IPC by CAT for use by its members and the PCB community. The designs are to be used exclusively for the support of the PCQR^2 database and related activities. The most current process capability panel designs are posted at www.pcbquality.com.

3.2 Panel Layouts The process capability panels consist of an array of 25.4 mm x 25.4 mm [1.0 in x 1.0 in] test modules, and a 25.4 mm [1.0 in] border that includes nomenclature and alignment features. Individual design layout maps can be found in the design documentation files posted at www.pcbquality.com. The test module types include conductor/space, via registration, via formation/reliability, soldermask registration, and controlled impedance.

3.3 Test Modules The test modules are designed to allow evaluation of detailed information on a range of feature types and sizes. Table 3-1 details the information that is obtained from each of the modules.

Table 3-1 Test Module Statistical Attributes

Module	Capability	Quality	Reliability
Conductor/ Space	Conductor and space yield	Conductor width and height control	–
Via Registration	Probability of breakout		–
Via Formation/ Reliability	Via yield	Resistance control	Cycles to failure
Soldermask Registration	Probability of encroachment		–
Controlled Impedance	Impedance control		–

3.4 Manufacturing Requirements Each of the designs has an accompanying documentation file that describes its specific features and manufacturing requirements.

4 TEST AND ANALYSIS

4.1 Testing and Data Analysis The panels **shall** be tested by CAT or by a third-party licensed by CAT and approved by the IPC D-36 Subcommittee. All data analysis, report generation, and posting to the database **shall** be performed by CAT. The type of measurement performed on each module is detailed in Table 4-1.

Table 4-1 Measurements

Test Module	Measurement Type
Conductor/Space	Precision Resistance
Via Registration	Resistance
Via Formation/Reliability	Precision Resistance
Soldermask Registration	Resistance
Controlled Impedance	Time Domain Reflectometry (TDR)

4.2 Via Reliability Testing

4.2.1 Assembly Simulation After initial capability and quality testing, representative via formation/reliability modules **shall** be subjected to six cycles of a convection solder reflow profile. The modules **shall** be preconditioned at 125 ± 5 °C for a minimum of six hours to remove residual moisture. The reflow profiles available for the assembly simulation are detailed in Table 4-2. The profile used will be AABUS.

Table 4-2 Assembly Simulation Profiles

Profile	Peak Temperature	Approximate Cycle Time
A	215 °C	4.0 min.
B	245 °C	6.0 min.
C	260 °C	6.0 min.

4.2.2 Thermal Cycling The via formation/reliability modules that were subjected to the assembly simulation process **shall** be thermal cycled using the Highly Accelerated Thermal Shock (HATS) reliability test methodology, which was developed for the IPC-PCQR^2 program. The temperature extremes and the number of cycles are detailed in Table 4-3. The number of cycles to 10% change in resistance and open circuit will be reported if they occur before the 500th cycle.

Table 4-3 HATS Cycle

Lower Temperature	Upper Temperature	Number of Cycles
-40°C	+145 °C	500 or until open

5 DATABASE

5.1 Data The data collected from each submission is compiled into the database that details the process capability, quality, and reliability demonstrated by fabricators. The data **shall** remain active for a period of twenty-four months from the posting date after which time it will be removed and archived.

5.2 Database Access Access to the database is provided only through an annual subscription from IPC, and is based on the subscribers' annual corporate electronics revenues. The Subscription License Agreement is available at www-.pcbquality.com.

5.3 Anonymity To maintain the anonymity of fabricators participating in the database, the IPC D-36 Subcommittee and subscribers **shall** refrain from discussions of specific fabricator identities and capabilities. The subcommittee will take all appropriate steps to ensure this anonymity.

5.4 Supplier Identity Request Subscribers may request the identity of fabricators participating in the database. The fabricators may choose to remain anonymous or may identify themselves by contacting the subscriber requesting the identification. Figure 5-1 details the supplier identity request process.

6 UPDATES AND REVISIONS

The design library and database will be reviewed and updated periodically by the IPC D-36 Subcommittee. Additions, deletions, and modifications will be made to the design library and database to reflect the needs of subscribers and fabricators. These revisions must be approved by the active subscribers. In all cases, the most current revisions **shall** be used and are the controlling documents. Requests to support archived designs more than three months old **shall** not be accepted.

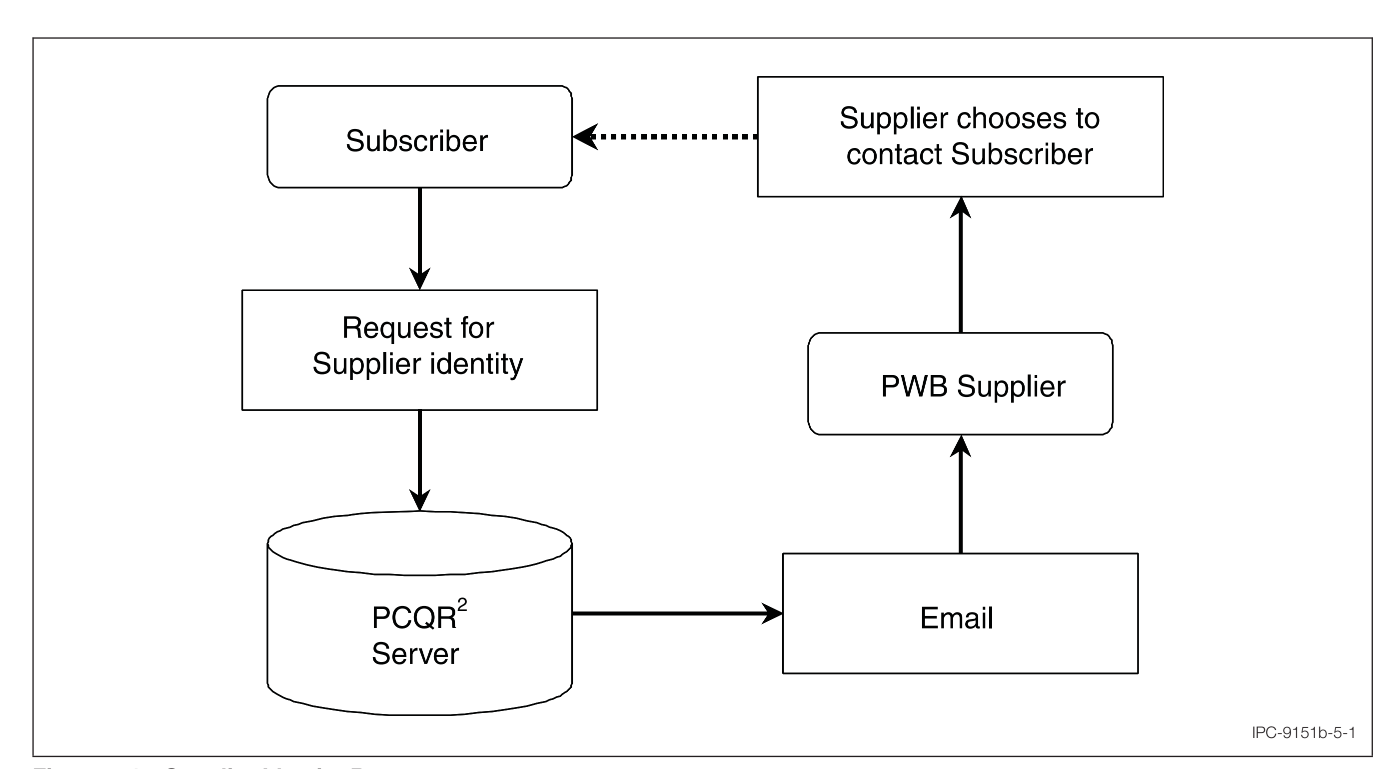
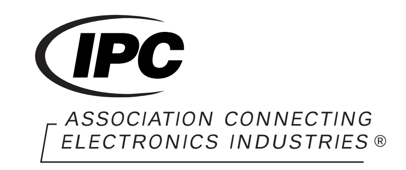


Figure 5-1 Supplier Identity Request



ANSI/IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits Definition Submission/Approval Sheet

The purpose of this form is to keep current with terms routinely used in the industry and their definitions. Individuals or companies are invited to comment. Please complete this form and return to:

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SUBMITTOR INFORMATION:

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Company: ______________________

City: ______________________

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Date: ______________________

❑ This is a **NEW** term and definition being submitted.
❑ This is an **ADDITION** to an existing term and definition(s).
❑ This is a **CHANGE** to an existing definition.

Term	Definition

If space not adequate, use reverse side or attach additional sheet(s).

Artwork: ❑ Not Applicable ❑ Required ❑ To be supplied
❑ Included: Electronic File Name: ______________________

Document(s) to which this term applies: ______________________

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Committee 2-30

Date of Initial Review: ______________________
Comment Resolution: ______________________
Committee Action: ❑ Accepted ❑ Rejected
❑ Accept Modify

IEC Classification

Classification Code • Serial Number

Terms and Definition Committee Final Approval Authorization:
Committee 2-30 has approved the above term for release in the next revision.

Name: ______________________ Committee: IPC 2-30 Date: ______________________

Technical Questions

The IPC staff will research your technical question and attempt to find an appropriate specification interpretation or technical response. Please send your technical query to the technical department via:

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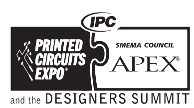
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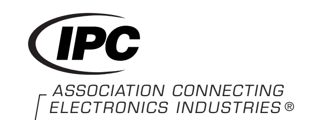
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For information on how to get involved, contact:
Jeanette Ferdman, Membership Director
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☐ One-sided and two-sided rigid printed boards
☐ Multilayer printed boards
☐ Flexible printed boards
☐ Other interconnections

Name of Chief Executive Officer/President____________________________________

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Name of Chief Executive Officer/President____________________________________

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This facility purchases, uses and/or manufactures printed wiring boards or other interconnection products for use in a final product, which we manufacture and sell.

What is your company's primary product line? ____________________________________

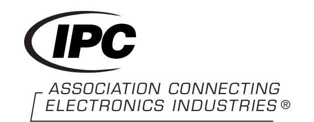
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What products do you supply?____

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Name of Primary Contact

Title | Mail Stop

Phone | Fax | e-mail

Company e-mail address | W

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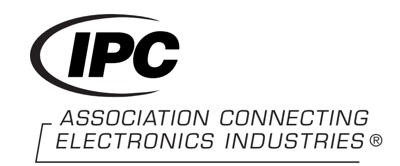
Mail application with check or money order to:

IPC
3491 Eagle Way
Chicago, IL 60678-1349

Fax/Mail application with credit card payment to:

IPC
3000 Lakeside Drive, Suite 309 S
Bannockburn, IL 60015-1249
Tel: 847-615-7100
Fax: 847-615-7105
http://www.ipc.org

Please attach business card of primary contact here



Standard Improvement Form

IPC-9151B

The purpose of this form is to provide the Technical Committee of IPC with input from the industry regarding usage of the subject standard.

Individuals or companies are invited to submit comments to IPC. All comments will be collected and dispersed to the appropriate committee(s).

If you can provide input, please complete this form and return to:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, IL 60015-1249
Fax 847 615.7105
E-mail: answers@ipc.org

1. I recommend changes to the following:

___ Requirement, paragraph number ________

___ Test Method number ________, paragraph number ________

The referenced paragraph number has proven to be:

___ Unclear ___ Too Rigid ___ In Error

___ Other ________________________________

2. Recommendations for correction:

____

____

____

____

3. Other suggestions for document improvement:

____

____

____

____

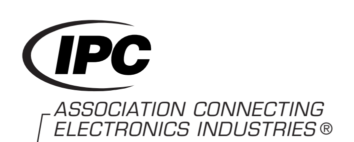
Submitted by:

Name ________________ Telephone ________________

Company ________________ E-mail ________________

Address ________________________________

City/State/Zip ________________ Date ________________



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